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LOOSE-HOUSING SYSTEM FOR DAIRY CATTLE

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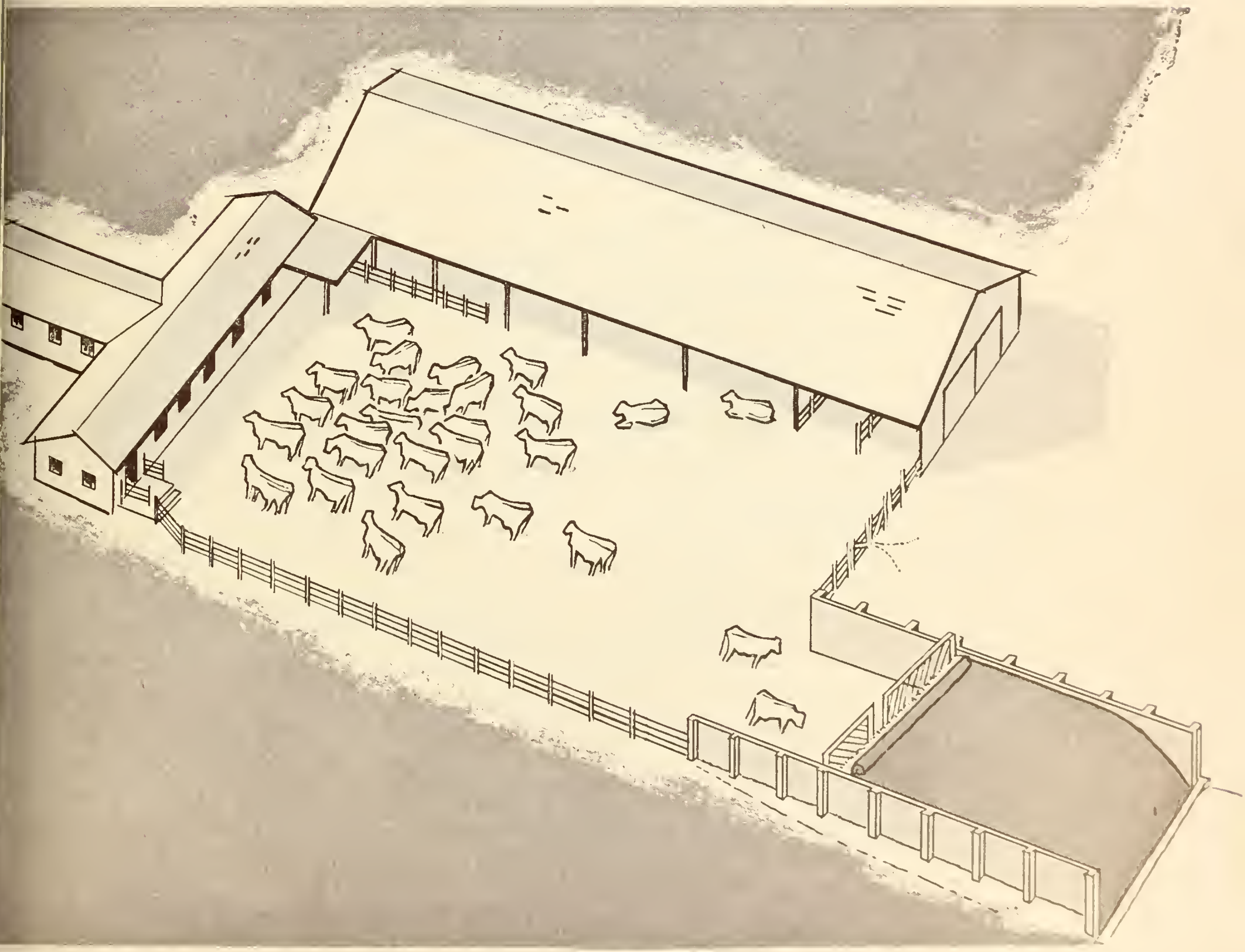
MISCELLANEOUS PUBLICATION NO. 859



U.S. DEPARTMENT OF AGRICULTURE

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ACKNOWLEDGMENTS

The authors gratefully acknowledge assistance received from representatives of State agricultural colleges and Federal agencies, as well as from manufacturers of building accessories, dairy equipment, and prefabricated buildings. This assistance included both helpful information and photographs for illustrations.

This is a revision of and supersedes Agriculture Information Bulletin No. 98, Loose Housing for Dairy Cattle, by Thayer Cleaver and Robert G. Yeck, agricultural engineers, Agricultural Engineering Research Division, Agricultural Research Service. The revision was prepared by J. W. Rockey, agricultural engineer, Agricultural Engineering Research Division, Agricultural Research Service.

The dairy housing terminology used in this bulletin is that accepted by the American Society of Agricultural Engineers in 1953.

REQUIREMENTS FOR PRODUCTION OF GRADE A MILK

Local and State health regulations regarding milk produced for sale within a city or other area usually include requirements affecting design, construction, and sanitation of farm dairy buildings. The buildings described and illustrated in this bulletin meet health requirements in most areas. However, any person planning farm buildings for the production of grade A milk should make sure that they will meet requirements specified where the milk is to be sold.

Washington, D.C.   Issued October 1961

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LOOSE-HOUSING SYSTEM FOR DAIRY CATTLE

The loose-housing system is a flexible arrangement of buildings and open lots developed for efficient milking and management of dairy herds. In this system the cows are kept in an open building, lot, or pasture and are not confined in stalls except while being milked. In contrast, the stall barn has a stall for each cow; cows are confined in their stalls during cold weather except for short exercise periods. Some dairymen are using elevated stall milking rooms with stall barns to ease the milking chore.

Cows handled under the loose-housing system do not suffer from cold because in winter they grow thick coats of hair and have shelter from wind, rain, and snow. During the winter in cold climates manure and bedding are allowed to accumulate in a resting area to form a soft bed on which the cows like to lie. The manure pack generates some heat. If well managed, cows keep as clean as or cleaner than in a stall barn and have less trouble from stiff hocks and swollen knees. In case of fire there is little danger of losing animals because they are not confined in a building.

The cows are milked in a separate room or building that usually accommodates only part of the herd at one time. Cows enter singly or in groups and are released immediately after milking. An expanding herd can be accommodated by milking more cows per stall and, if necessary, using a larger milk cooler.

Loose housing is not a new system, but it has been greatly improved in recent years. Hay and silage can now be mechanically or self-fed, and tractor manure loaders or power scoops eliminate hand labor in removing the manure pack and cleaning the feeding and resting areas.

The loose-housing system has some disadvantages. Men caring for the animals are more exposed to weather than when a stall barn is used. If the resting and feeding areas are not definitely separated, much more bedding may be required to keep cows clean. However, if the system is well arranged and managed, little more, and sometimes less, bedding is required than in a stall barn.

A complete loose-housing layout has (1) a milk area, which includes a milking room or barn, and a milkhouse or milkroom, with pertinent utilities; (2) roughage and concentrate feeding facilities for cows and young stock; (3) storage space for hay, silage, and bedding; (4) resting areas for adult and young stock; (5) maternity, hospital, and calf pens; and (6) an open lot (fig. 1).

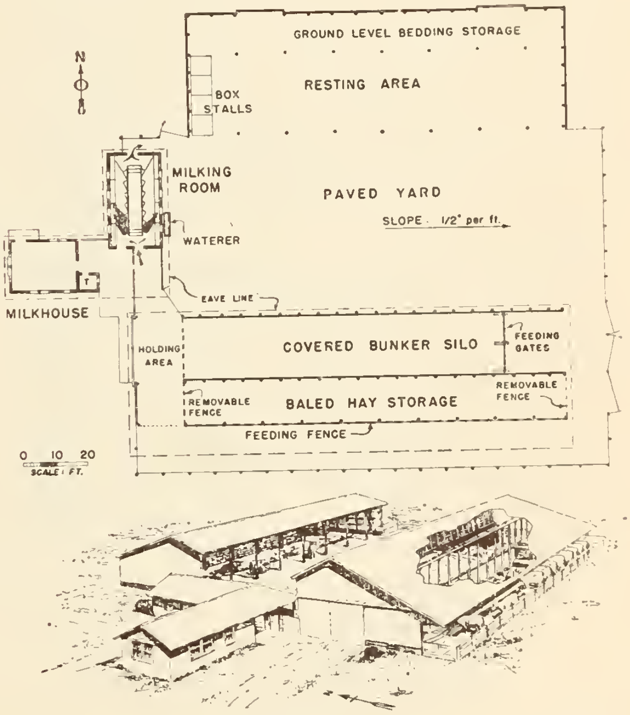

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Figure 1.—An efficient U-shaped, loose-housing layout for a 50-cow herd. Made up by grouping Exchange Plans Nos. 5868, 5832, and 5848 for the milk, resting, and feeding areas, respectively, around a central paved yard.

In the mild climates of the South and Southwest, where cows are on pasture most of the year, building requirements are greatly simplified and only the milk area buildings may be needed.

MILK AREA

Milking Rooms and Barns

Where good-quality milk is to be produced, a milking room or barn has several advantages. A minimum of labor is required for milking and related chores. Good sanitation can be maintained with little effort because the milking room is small, cows are in it only for milking, and cleaning facilities are convenient. With elevated stalls, practically all bending and stooping are eliminated, and milking is much less tiring. This is particularly noticeable with larger herds.

The milking room may be built of masonry, frame, or metal. Concrete floors are generally used. Interior walls and ceilings must be of materials that can be kept clean easily.

A building housing an elevated, 3-in-line, side-entering stall milking room, milkroom, feed storage, and lavatory under one roof is shown in figure 2.

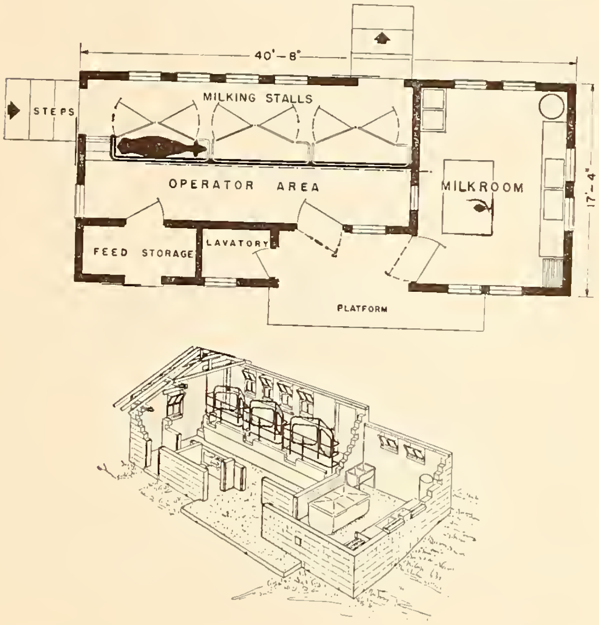

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Figure 2.—Exchange Plan No. 5875: Elevated, 3-in-line, side-entering stall milking room, with milkroom, feed storage, and lavatory.

Some milk regulations require a separate milkhouse, and some dairymen prefer overhead or outside bin storage for concentrates, with gravity or mechanical distribution. With this stall arrangement and a milk pipeline, one man can milk 20 to 30 cows an hour.

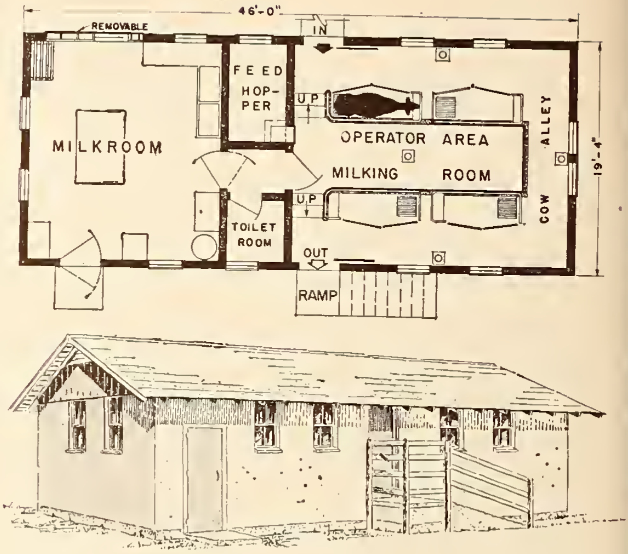

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Figure 3.—An efficient arrangement of four elevated, side-entering stalls for piped or hand-carried milk. Exchange Plan No. 5736 shows designs for three-stall and larger milking rooms in the U-shaped arrangement, with alternate milkroom and feed-handling arrangements.

A U-shaped milking room can be arranged for three, four, five, or more elevated, side-entering stalls. In a four-stall building (fig. 3) one man can milk 25 to 35 cows per hour or, with a helper, 35 to 45 per hour.

A four-stall milking room with elevated, tandem walk-through stalls is shown in figure 4. Two cows

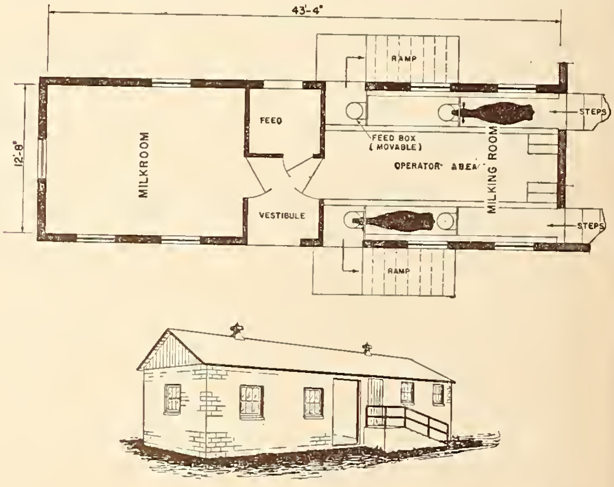

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Figure 4.—A milking room with elevated, double in-line, walk-through stalls, often called chute or lane-type stalls.

enter together on each side of the milking room and leave together. Feedboxes separate the stalls and are moved aside to let cows out. This type of building may cost a little less than those shown in figures 2 and 3. Milking rates are about the same as in U-shaped, side-entering stall rooms.

A floor-level abreast walk-through arrangement is shown in figure 5. The stall fronts swing aside to permit cows to leave after being milked. With this arrangement 2 men can feed and milk 25 to 40 cows per hour. Feedbins are between each pair of stalls.

Figure 6 shows a type of milking barn used in many parts of the South and West. Stalls and stanchions are similar to those in a stall barn but are often simpler and cheaper. The rear gutter is shallow or is omitted, since cows are in the barn only for milking. From one-eighth to one-half as many stalls are provided as there are cows to be milked. One man with 2 machines can milk 15 to 20 cows per hour with this system. With 4 machines and piped milk he may milk 25 to 30 cows per hour. The cost per stall is considerably less than that for elevated stalls. Total cost, however, may be greater because more stalls are required to handle the same size herd.

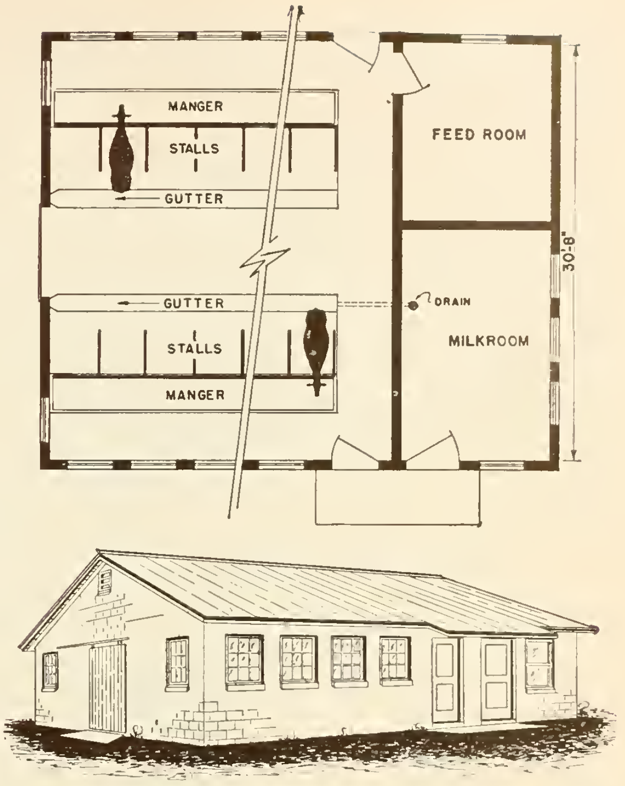

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Figure 6.—Milking barn for use in a loose-housing system. After the cows are milked, they back out of the stalls.

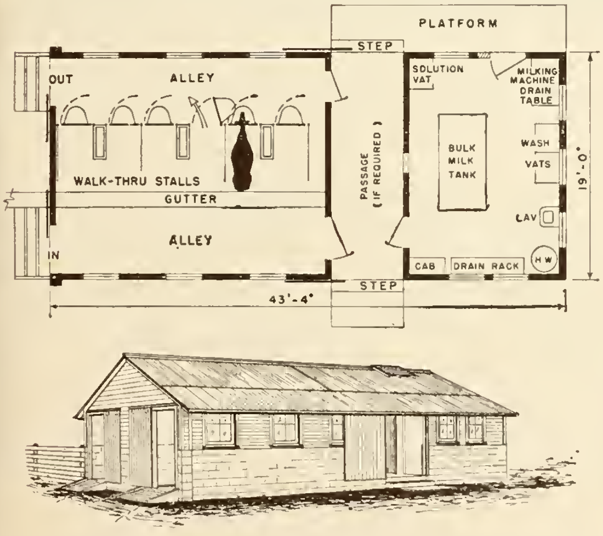

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Figure 5.—In this floor-level, walk-through milking room, the cows stand abreast. After milking, the stall front is swung aside to permit the cow to leave.

The herringbone milking room is a compact, efficient, two-level, walk-through, pipeline arrangement with a multiple stall on each side of a central operator area (figs. 7 and 8).[1] A milking unit is provided for each pair of cow positions. Facilities for feeding concentrates during milking are usually provided. Cows enter and leave in groups and are positioned for milking by the shape of the stall rail and endgates. There are no separating partitions between the cows.

The herringbone has gained popularity rapidly since its introduction into the United States in 1957. It is adaptable to herds of different sizes and to one or more operators.

In a double-4 (4-position stall on either side) herringbone arrangement, a single operator should milk 30 to 35 cows per hour; in a double-5, 40 to 45; and in a double-6, 50 to 55. To operate a double-5 successfully, the operator needs a little better than average speed and alertness. The double-6 demands a fast pace and a high degree of alertness on the part of the operator, well-trained cows, and reliable equip-

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[1] For further information on the herringbone, see U.S. Dept. Agr. Prod. Res. Rpt. No. 45, The Herringbone Milking System—Economic Appraisal, Labor Efficiency Analysis, and Adjustment Possibilities.

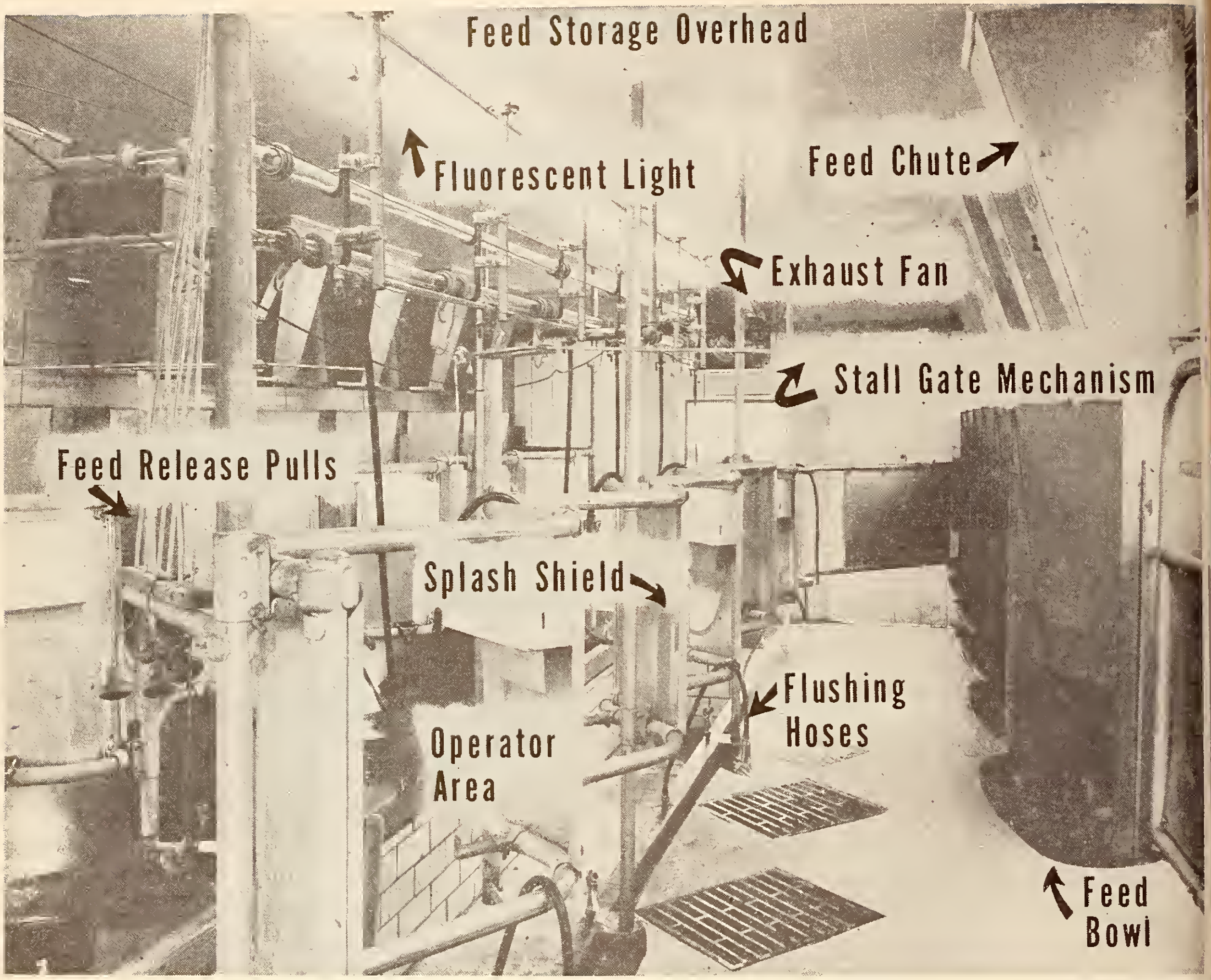

FIGURE 7.—Interior of herringbone milking room. Feed pulls release measured amounts of concentrates to bowls. Cow entrance and exit doors are in line with stalls. Continuous gratings may be used in lieu of individual gratings for drain openings in floor of stall platforms.

ment. It is recommended for one-man operation only when all these conditions can be met. The double-6, double-8, and double-10 are suited to two-man operation. In new construction, space for five or six stall positions could be provided, but only four positions used until the necessary skill and experience are acquired.

The cost of a double-4 herringbone milking room and milkroom fully equipped is estimated to run about 10 percent higher than that of a similarly equipped double-3 elevated, tandem walk-through or double-2 elevated, side-entering installation. However, on a per cow milked basis (assuming a 2-hour milking period), it is estimated to be about 20 to 30 percent less.

Milkhouse or Milkroom

State and local grade A milk regulations are based on, but frequently deviate from, the "Milk Ordinance and Code—1953 Recommendations of the Public Health Service." These specify a milkhouse constructed as follows:

"* * * (a) The milk house or room shall be provided with a smooth floor, constructed of concrete or other impervious material, maintained in good repair, and graded to provide proper drainage. (b) It shall have walls and ceilings of such construction as to permit easy cleaning, and shall be well painted, or finished in an approved manner. (c) It shall be well lighted and well ventilated. (d) It shall have all openings effectively screened, including outward-opening self-closing doors, unless other effective means are provided to prevent the entrance of flies * * *"

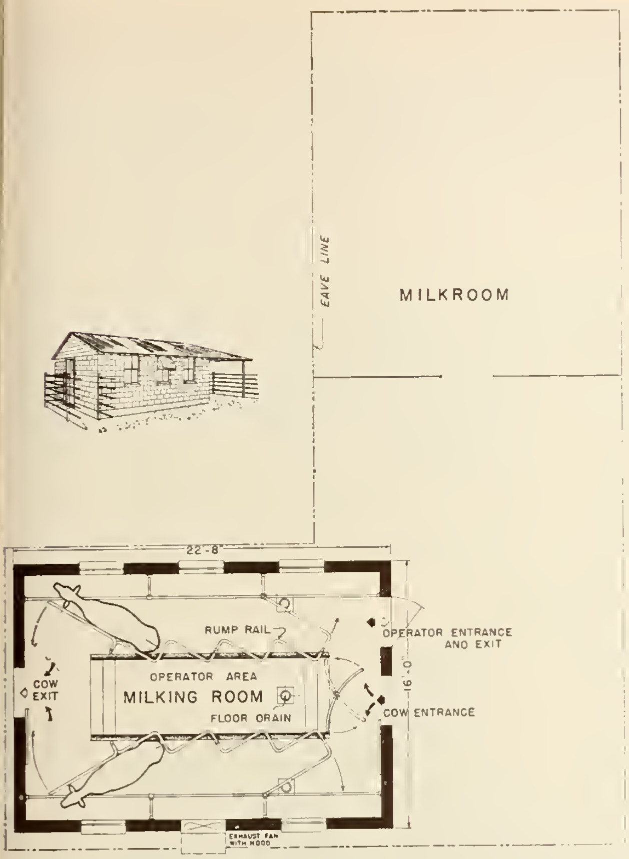

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Figure 8.—Exchange Plan No. 5868 shows designs for a one-story, double-4, -6, and -8 herringbone layout, with alternate milkhouse and concentrate feeding arrangements. Cows enter and leave by center doors. Detached milkhouse is required by some milk codes; others permit an attached milkroom.

The milkhouses and milkrooms illustrated in this bulletin will meet the requirements for production of grade A milk in most localities. Where they do not, usually only minor changes are required. In some areas, for example, the milkhouse must be separated from the milking room by a vestibule or passage. Minimum equipment will usually be a milk cooler, a water heater, wash vats, a can rack, a drying table, and storage cabinets. Pumping, cleaning, and control accessories will be needed if milk is piped. For bulk milk handling, a refrigerated bulk tank and its accessory equipment will replace the can rack and can-type cooler.

Equipment in the milkhouse or milkroom should be located so as to simplify installation and cleaning of a milk pipeline, permit ready access for thorough cleaning of all areas and equipment, and provide for convenience in accomplishing the chores. Clearance of at least 36 inches should be provided between the working side of a bulk tank and any wall or other equipment. Clearance of at least 24 inches should be provided on the other sides.

Figure 9 shows the interior of a modern milkhouse or milkroom.

Milk is being handled more and more in bulk, and it is wise to build the milkhouse or milkroom so that it will accommodate an appropriate sized bulk tank and its accessories. A door or removable wall panel large enough to allow passage of the tank should be provided. Dimensions and clearances for equipment items may be obtained from dealers.

Suggested minimum inside dimensions for milkhouses or milkrooms where grade A milk is sold to a processor are:

Daily milk production (gallons)	Floor space	
	For every-day pickup (feet)	For every other day pickup (feet)
Under 50	12 x 14	12 x 14
50 to 100	12 x 16	12 x 18
Over 100	12 x 18	12 x 20

These sizes do not include space for pouring platform, boiler, or compressor room.

Feed Handling in the Milk Area

Overhead (fig. 10) or outside (fig. 11) storage bins and auger or other mechanical distribution systems can save appreciable time and effort in handling concentrates. Many dairymen purchase feed delivered in the storage bin on a regular schedule and distribute it mechanically as needed. Mixed rations may also be handled this way, or they may be mixed mechanically on the premises from components delivered to separate storage compartments and then distributed to the stalls.

The amount of storage needed for concentrates depends on the feeding ratio and the frequency of delivery. At the rate of 1 pound of concentrates to 4 pounds of milk, a cow giving 8,000 pounds of milk a year would require 1 ton of concentrates per year. On a weekly delivery schedule, 10 cows fed at this rate would require about 35 cubic feet of concentrates storage.

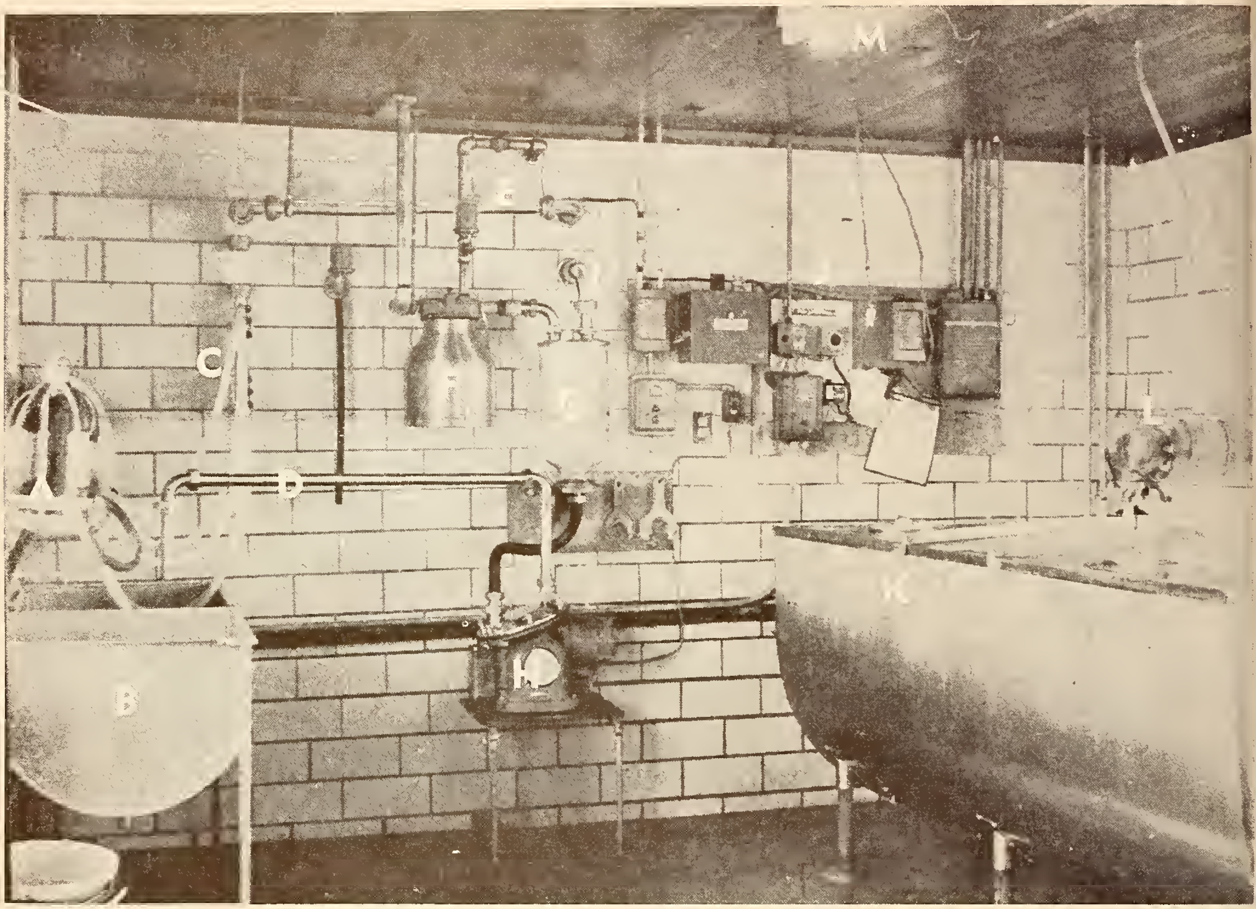

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Figure 9.—Milkroom with cleaned-in-place milk pipeline and refrigerated bulk milk tank. (a) Cup rack, (b) wash vat, (c) header for washline, (d) rotatable milk fill and wash return pipe, (e) glass washline, (f) milk splash trap, (g) milk collector and releaser, (h) milk pump, (i) glass milk pipeline, (j) electrical control panel, (k) bulk tank, (l) milk agitator, (m) fluorescent light.

Plumbing for the Milk Area

Hot and cold potable (drinkable) water under pressure are essential for proper milk area sanitation. Hot- and cold-water outlets are needed in the milkhouse or milkroom for washing utensils and pipelines, wall and floor flushing, and general cleanliness. A mixing type faucet will permit convenient adjustment of water temperature. If the bulk milk cooler refrigeration system has a water-cooled condenser, it may be used to preheat the water.

Outlets are needed in the milking room for washing udders, flushing the premises, and general cleanliness. Warm water is desirable for udder washing and can be readily obtained by locating a mixing valve at a convenient point.

Hose connections are needed for flushing the holding area pavement. A booster pump to provide flushing pressures of 60 pounds per square inch or more is desirable.

Floor drains with water-seal traps to keep out odors are needed in the stall and operator areas of the milking room and in the milkhouse or milkroom. Drainage should be provided to comply with sanitary codes and should not be discharged on the surface in the vicinity of buildings or lots.

The simplest method for disposing of milk area drainage is piping it to an out-of-the-way grassy area and discharging on the surface, but a major objection is that the discharge area usually becomes a nuisance. A variation of this method is piping to a shallow lagoon. The lagoon requires periodic removal of accumulated solids, which can be accomplished by having an alternate lagoon to use while one is drying and being cleaned. Lagoons are not entirely free of

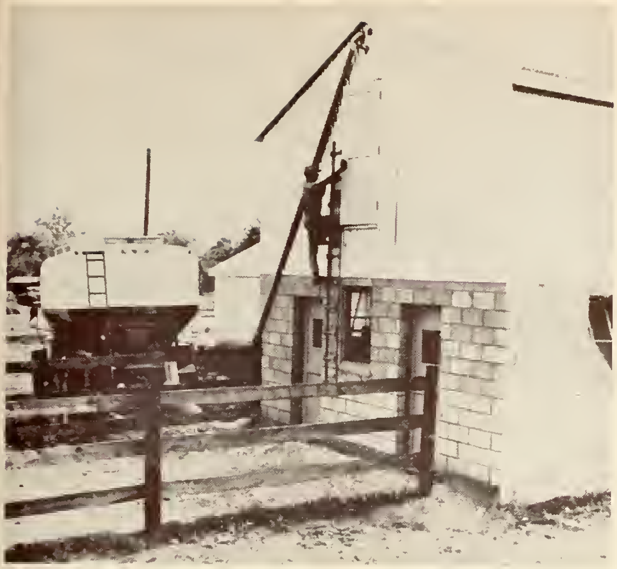

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FIGURE 10.—Concentrates blown from truck through delivery tube to overhead storage. Metered amounts fed by gravity to individual hoppers in milking room below.

PN-1024

FIGURE 11.—Outside feed storage bin, with mechanical auger distribution to milking room.

odor and should be located accordingly. If the drainage can be used for irrigating, it may be run to a settling tank or manure pit. From there it may be pumped to the irrigation system or to a tank wagon for spreading. The tank or pit should hold at least a week's flushings, should have a screen to keep out fibrous materials, and may need agitation to keep the manure flowable. Soil absorption, similar to that for domestic sewage, is also used to some extent but is subject to clogging and subsequent nuisance.[2]

If a flush-type toilet is installed, the flushings should be handled as sewage in the same manner as household sewage and should be kept separate from the milking room and milkhouse or milkroom wastes.

Ventilating and Heating

Minimum requirements for ventilating the milking room and milkhouse or milkroom are usually set forth in State and local regulations. Screened doors and windows and ceiling vents connected to roof ventilators (fig. 4), to ridge ventilators (fig. 5), or to louvered openings in walls (fig. 6), usually provide adequate ventilation. Screened wall inlets near the floor are sometimes required to help dry wet floors. An exhaust fan installed in a wall (fig. 7) or mounted in a window frame (fig. 8) will increase air circulation and provide more comfort for both cows and operators. Where winters are mild, parts of the walls may be omitted to give better air circulation. All wall openings and ventilating ports should be screened and fly tight.

Except in warm climates, heating equipment is needed to prevent freezing of the water system and to provide a temperature of 45° to 50° F. for the operator. Between milkings the temperature in the milking room need not be more than about 40°. During the milking period the heat from the cows will help warm the room. Heat lamps or electric heating cable may protect the water system, but where the weather is severe heat is also desirable for the operator.

Heaters are available that can be placed on the floor, mounted on a wall, or suspended from the ceiling. A 3,000-watt electric unit should provide enough heat for a two- or three-elevated-stall milking room if the building is tight and well constructed and has good ceiling insulation. A gas heater having a capacity of 15,000 to 20,000 B.t.u. per hour or an oil heater burning 1 quart of oil per hour will supply heat quickly and have reserve capacity. Use of storm sash on the windows and storm doors should lower heating costs.

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[2] For a fuller discussion of disposal of these wastes, see Engineering the Farmstead, by J. W. Rockey and S. S. DeForest. *In* Power to Produce (1960 Yearbook of Agriculture, pp. 265–267).

Infrared heat lamps are useful for operator spot heating. A minimum installation would be one 250-watt lamp suspended over each operator standing position in a milking room, or over every other position in a herringbone. Additional lamps up to one per foot may be used for greater comfort or more severe conditions. The operator can vary the heat by wiring alternate lamps in separate circuits.

Lighting the Milk Area[3]

Good lighting is necessary for milking operations and for proper cleaning and sterilizing of milking equipment. In the milkhouse or milkroom one 100-watt incandescent bulb (or equivalent fluorescent tube) above the wash vats and another above but near the cooler and can rack are usually enough. Lights should be at or near the ceiling if it is not over 8 feet high.

In the milking room it is important to have good light on flanks, udders, and teats. Light fixtures may be suspended over the operator area, about 7 to 8 feet above the floor. In single-sided milking rooms they may be mounted high on the wall opposite the milking stalls. At least two lights, 100-watt minimum each, should always be provided. If there are more than two stalls in line, or an equivalent length of herringbone, at least another light for each additional two stalls of length should be added. The lights should be placed where they will not cast shadows on work areas. Fixtures may be installed in the stall floor or curb to spotlight each udder area. If installed, they must be protected by a heavy glass cover with a watertight seal.

In a milking barn, 100-watt bulbs should be spaced 12 to 15 feet apart above the center of the operator area and 20 to 32 feet apart above the center of the feed alley. Lights should be 8 to 9 feet above the floor.

Holding Area

A paved area should be provided just outside the milking room entrance in which to "hold" the cows until they are wanted for milking. This area may be part of the barnyard or other convenient area but should not be part of the resting area. It may be open or covered but should be sheltered from severe weather, and it should contain about 15 square feet per cow. In hot, unshaded areas, up to 18 square feet per cow is desirable.

The area may be closed off by conventional fencing and gates, a movable "hot" wire, or an automatic moving gate that will continually "crowd" the cows toward the milking room entrance. It should be laid out to facilitate daily cleaning with mechanical equipment.

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[3] For further information on lighting, see Farmers' Bulletin No. 1838, "Electric Light for the Farmstead."

FEEDING AREA

Arrangements for Feeding Roughages

Feeding arrangements for the winter season or when pastures are not available may be provided outdoors or under roof, depending on the climate.

If hay or silage is fed inside a building, the feeding area should be separated from the resting area. Doors and interior posts should be arranged so that the feeding area can be cleaned with tractor equipment. To simplify feeding, hay should be stored under roof beside the feeding area or in a mow above it, if possible. In dry climates hay may be stored and fed with no weather protection.

Figure 12 shows a hay shed for storing and feeding baled hay. Feeding fences or gates that are moved back as the roughage is eaten may be used either indoors or outdoors, and may be used for baled or chopped hay.

Silage can be fed in bunks in an open lot (fig. 13) in most climates, but where winter weather is severe it may be necessary to feed indoors because cattle will not eat much frozen silage. To conserve space,

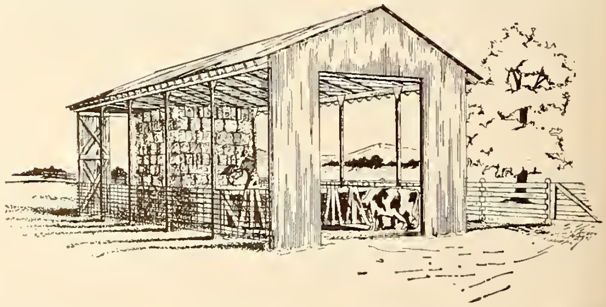
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FIGURE 12.—Exchange Plan No. 5847, shed for storing and feeding baled hay. Several types of feeding fences and gates are shown on Exchange Plan No. 5872.

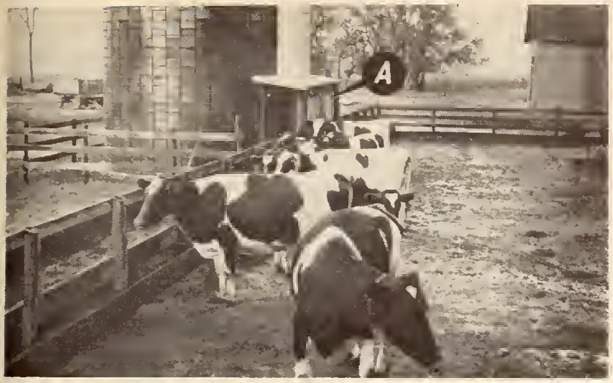

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FIGURE 13.—Silage may be hand or mechanically fed in long bunks. Hinged doors (A) may be swung upward after silage is distributed. A silo unloader will further reduce time and labor.

silage may be fed in the same manger or bunk as hay. Mechanical unloading and distribution will save appreciable time and labor in feeding.

Silage stored in a trench or bunker silo can be self-fed by using a movable feeding fence. A roof over the silo makes it especially suitable for cold or rainy areas (fig. 14).

If cattle have access to roughage at all times, 12 to 18 inches of bunk, manger, or feeder space per cow is ample. If roughages are fed in batches so that all animals must eat at the same time, each cow will need from 24 to 30 inches of manger space. In either case, cows should be dehorned. A paved strip at least 10 feet wide is needed around feed bunks and other feeding areas. A paved strip should also connect feeding and resting areas if the entire lot is not paved.

Tables 1 and 2 give the amounts of roughages required per 1,000-pound cow for feeding periods of different lengths. Table 3 gives the space per ton required to store various types of feed. Total storage space necessary for a particular herd can be approximated from these tables.

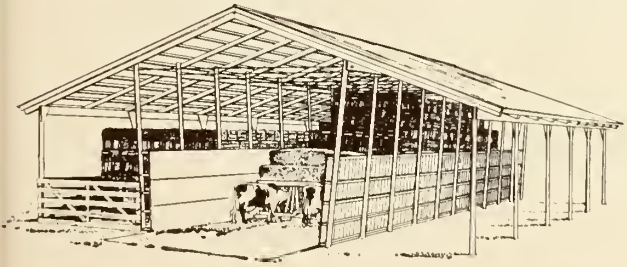

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FIGURE 14.—Exchange Plan No. 5848, roofed bunker silo with optional sheds. Baled hay or straw may be stacked on top of silage or under sheds. Hay may also be fed under sheds. Feeding fences and gates shown in Exchange Plan No. 5872. Other bunker silo designs shown in Exchange Plans Nos. 5829, 5843, and 5865.

TABLE 1.—*Hay requirements per 1,000-pound cow for various feeding periods*

Type of feed	Feeding period	Amount of hay fed	
		Per day	Total
	Days	*Pounds*	*Tons*
Hay alone	210	25	2.6
	175	25	2.2
	120	25	1.5
Hay and silage	210	[1] 15	1.6
	175	[1] 15	1.3
	120	[1] 15	.9

[1] Hay requirements will be lower if cows get all they want of top-quality silage.

TABLE 2.—*Silage requirements per 1,000-pound cow for various feeding periods*

Type of feed	Feeding period	Amount of silage fed	
		Per day	Total
	Days	*Pounds*	*Tons*
Hay and silage	210	30	3.2
	175	30	2.6
	120	30	1.8
Silage [1]	210	60	6.3
	175	60	5.3
	120	60	3.6

[1] Assuming that some good-quality hay is fed.

TABLE 3.—*Approximate storage space required for cattle feeds*

Type of feed and form of storage	Approximate storage space required per ton	
	Maximum	Minimum
Loose hay:	*Cubic feet*	*Cubic feet*
Shallow mows	575	450
Deep mows	450	400
Baled hay:		
Loose bales	300	250
Tight bales	200	135
Chopped hay:		
Long cut (2½ inches or more)	360	250
Short cut (less than 2½ inches)	250	200
Silage:		
25 feet in depth	50	44
35 feet in depth	44	40
Mixed concentrates	45	....

Water Supply

A milking cow requires about 15 gallons of drinking water per day when temperatures are below about 60° F. In hot summer weather she will drink about 30 gallons. In addition, another 15 to 30 gallons may be needed for general sanitation purposes.

Waterers should be located near the feeding area, but not in the resting area. If exposed to freezing conditions, they should be provided with protective heating devices. The area around a waterer should be paved for at least 10 feet. Suggested locations are shown in figures 16 and 17.

One automatic waterer should serve about 25 cows. A nonsiphoning type that complies with local code requirements or U.S. Public Health Service recommendations should be used. If a watering tank is used, a float control should be provided.

Water pipes should be placed below the frostline or protected by devices like electric heating cable. Outlets and faucets should be placed to avoid damage to or by vehicles and animals.

Lighting the Feeding Area

Electric lights with conveniently located switches are needed in all feeding areas and open lots. In buildings, one 100-watt bulb (or equivalent fluorescent tube) centered 6 to 9 feet above bunks and mangers is sufficient for each 20 to 25 feet of length. For high hay feeders the lights should be 6 to 8 feet to one side and 9 to 12 feet above the floor, where braces or beams do not cause bad shadows. For upright silos, one 100-watt bulb for the chute and another for the silo should be placed near the top and within easy reach of the chute ladder.

For self-feeding horizontal silos, one 100-watt bulb with weatherproof reflector is needed at the side of the entrance. It should be mounted on a pole 12 to 15 feet above the floor. One 200-watt bulb with reflector, about 15 feet above the ground, is recommended for open lots for each 10,000 to 15,000 square feet of area. Lights should be located so as to illuminate the work centers most effectively.

RESTING AREA

The resting area is a building or space where cows can rest or lie down on a dry bed (fig. 15). It should provide shelter from cold winds, snow, and rain; and exposure to winter sun. An open-front building facing south, east, or away from prevailing winter winds and kept well bedded is satisfactory in most climates. In areas having severe winter storms and low temperatures, the front may be partly closed. The resting area should not be used as a holding or exit area for the milking room, and all feeding, watering, or other cross-traffic should be excluded.

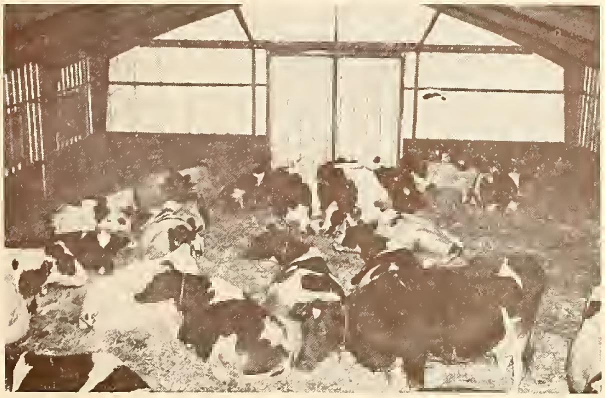
PN–1028

FIGURE 15.—Resting areas with deep manure packs provide shelter and warmth during the winter. The door shown in the background can be opened for removal of manure.

During late fall, winter, and early spring in all but the mildest climates, bedding and manure may be allowed to build up a deep pack that generates some heat. Few if any injuries occur to hocks, knees, udders, and teats of cows resting on a manure pack, and most of the fertility of the manure is conserved. Flies are not a menace during cold weather, but the pack should be removed before the fly season. The space can then be used like any other cattle shed and cleaned as necessary to control flies. If the pack is allowed to remain until it is wanted for spreading, it must be thoroughly covered with dry straw and the cows excluded. Rising summer temperatures are apt to increase the odors that are carried toward the dwelling by the summer breezes.

Earth floors may be satisfactory for resting areas, providing they are 8 to 12 inches above grade and the surface outside is sloped away from the building to provide good drainage.

With open-front buildings there should be a paved approach strip at least 20 feet wide along the entire front. Most of the mud or manure on the cows' feet will drop off on this paved approach. Power equipment for removing manure can also work more effectively on this strip.

The space per cow required in resting areas depends on size of cow, arrangement of space, and climate. With a good, properly managed layout, 40 square feet per animal for the smaller breeds and warmer climates to 60 square feet for the larger breeds and colder climates should be satisfactory.

The manure pack may be 2 to 4 feet deep, depending on length of the housing season, how often the pack is removed, time the cows spend in the resting area, floor space allowed per cow, and amount of bedding used. Wood members in contact with manure should be pressure treated with preservative. Space near the open front of a covered resting area may not provide good shelter and might be discounted for this reason. Space used as a passage or walkway should not be counted as part of the resting area. At least 9½ feet of headroom at the eaves or doorway is needed if a tractor-mounted manure loader is used for cleaning. Posts or poles should be spaced at least 12 feet apart in each direction for free movement of cleaning and other equipment.

The quantity of bedding required is affected by length of housing season, arrangement of buildings, space allowance per cow, climate, and management. The Wisconsin Agricultural Experiment Station reported the use of 1,522 pounds of bedding per 1,436-pound cow during a housing season of 182 days. This was an average of 8.4 pounds per cow per day. Droppings were turned over or thrown to the unused edges or thin spots of the manure pack once or twice a day. Most Northern States recommend use of 12 pounds or more of bedding per day for each animal. On the other hand, some farmers in central Illinois use less than 500 pounds for each cow per season, and in some Southern States little or no bedding is used.

In a one-story building, bedding can be stored alongside the resting area, protected by a temporary fence. From 10 to 15 square feet per cow of the resting area can be used for bedding storage at the start of the season. As the bedding is used, the fence can be moved back to provide more space in the resting area. A ton of ordinary bales of straw occupies about 200 to 300 cubic feet, depending on the density of the bales.

Summer shade and free air movement in resting areas are as necessary as protection from winter storms, particularly in the Southern States. Windows or wall panels that can be opened for light and summer ventilation are needed. If plenty of baled bedding is available, siding may be omitted from the building and bales may be stacked at the ends and back of the resting area to form walls in the winter. In the spring the unused bedding can be shifted to open up the walls for more air circulation. In very mild climates shades 10 to 12 feet high and without walls are adequate. Placing the long axis east to west shades the ground longer in one area and may make the shelter cooler. Placing the long axis north to south admits more sun to dry out wet spots, should they develop, if the shade is not over 20 feet wide. Roofs may be of metal, hay, or straw.

Electric light is needed in the resting area. One 100-watt bulb or equivalent mounted 10 to 14 feet above the floor will provide adequate light for about 1,000 square feet of resting area, if beams and braces do not cause bad shadows. The light should be controlled by a wall switch near the entrance most used.

YOUNG STOCK, MATERNITY, HOSPITAL, CALF, AND BULL PENS

In a well-managed dairy herd, usually about 50 percent of the animals will be milking cows; 5 to 8 percent, dry cows; 25 percent, heifers 10 months to freshening; 12 percent, calves 6 weeks to 10 months; and 5 to 8 percent, calves under 6 weeks.

Older calves, yearlings, and 2-year-olds can be handled in their own separate feeding and resting areas. Space for calves, maternity pens, and hospital pens is best provided in separate buildings but can adjoin the resting area. Recommended sizes for pens are presented in table 4.

Table 4.—*Recommended dimensions for cattle pens*

Type	Length and width		Height
	Minimum	Maximum	
	Feet	*Feet*	*Feet*
Cow pens	10×10	12×12	4½
Individual pens for small calves	6×4	6×6	4
4-calf pens [1]	10×10	12×12	4½

[1] Allow 25 to 35 square feet of area and 20 to 25 inches of manger space per calf, depending on size.

All pens should be of panel construction, easily detachable at the corners so they can be moved when the manure pack is removed. Panels should be lifted occasionally as the manure pack builds up.

If calf pens are in the resting area, they should be near the open east or south side to let the calves get sunshine. Pens for young calves should be boarded up tight to a height of 4 to 4½ feet above the floor to lessen drafts. For individual calf pens, a false floor 2½ to 3 inches above the pen floor can be built of slats or stiff wire netting. This allows urine to drain through the bedding.

Bulls should not be housed with other cattle but, if kept, should be in a separate shed with adjoining open lot.

LAYOUTS FOR LOOSE HOUSING

The site for a loose-housing system should provide space for buildings, lots, driveways and turnarounds for vehicles, and expansion. The layout in figure 16 is for use in a cold climate. In mild climates buildings may be separated and the feeding or resting barn may be omitted (fig. 17).

A complete loose-housing layout for 20 cows is shown in figure 16. If young stock are housed elsewhere, the layout is ample for 25 cows. The resting area allows 47 square feet per cow at the beginning of the housing season and 50 square feet before midwinter. This is exclusive of bedding storage and a maternity or hospital pen. Feeding and resting areas are separate and face south for protection from cold winds. For drainage, the paved lot is sloped away from the buildings 1 foot in 50.

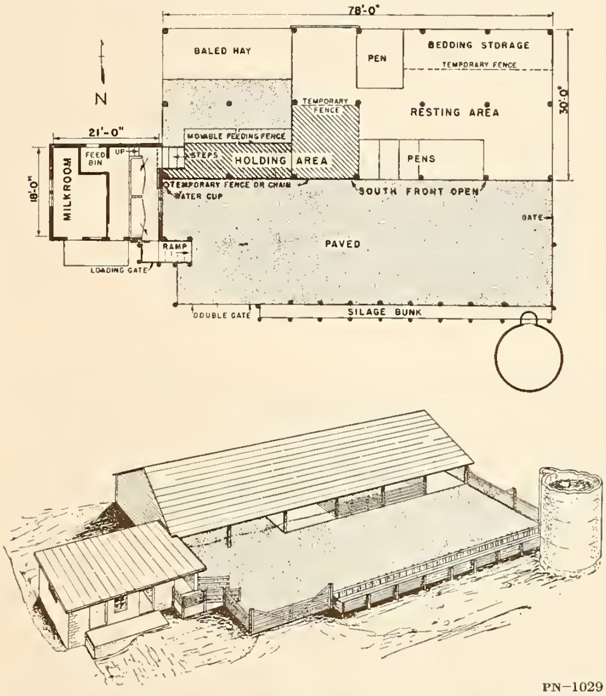

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Figure 16.—A loose-housing layout adapted for a 20-cow herd. It is also ample for 25 cows if young stock are housed elsewhere. Silage feeding could be mechanized. Alternate arrangements would include interchanging the positions of the milk and feeding areas or using a self-feeding bunker silo.

In this arrangement cows enter the milking room from a holding area adjoining the hay-feeding area. Cows are milked from the right side and exit into the paved lot. Entrance and exit doors and stall gates are controlled from the operator area by a system of small cables or ropes and pulleys. Hay and bedding are stored on the ground. All calf pens are of tight, movable panels and are located next to the open front of the resting area where they can get the winter sunshine.

Silage can be fed from an upright silo and bunk, as shown on the plan, or from a horizontal silo. Arrangements can also be made for mechanical or self-feeding.

Exchange Plans Nos. 5830, 5831, and 5832 show pole-type buildings suitable for loose-housing layouts.

A layout suitable for larger herds in mild climates is the wagon-wheel or pie-shaped arrangement shown in figure 17. This layout can be used with either a milking barn or a milking room. When used with a milking barn, all that is needed for cow movement to the barn is an open court between the barn and the narrow end of the pens or corrals. The barn may accommodate one or more corrals of cows at one time.

When used with a milking room, as in the diagram, some means must be provided for a continuous movement of cows through the milking room. This is done by admitting a corral of cows to the washing pen, then to the holding pen, and then to the milking room as needed. When the cows from the first corral move from the washing pen to the holding pen, the cows from the second corral are admitted to the washing pen. On leaving the milking room, the milked cows return via the exit lane to their respective corrals. Traffic flow is controlled by proper manipulation of the corral and pen gates.

Feed bunks along the outer perimeter are filled from a self-unloading wagon. The feeding, watering, and holding areas are paved. Shades may be provided in the corrals. For the North, shelters to protect against snow, freezing rain, and wind should be provided.

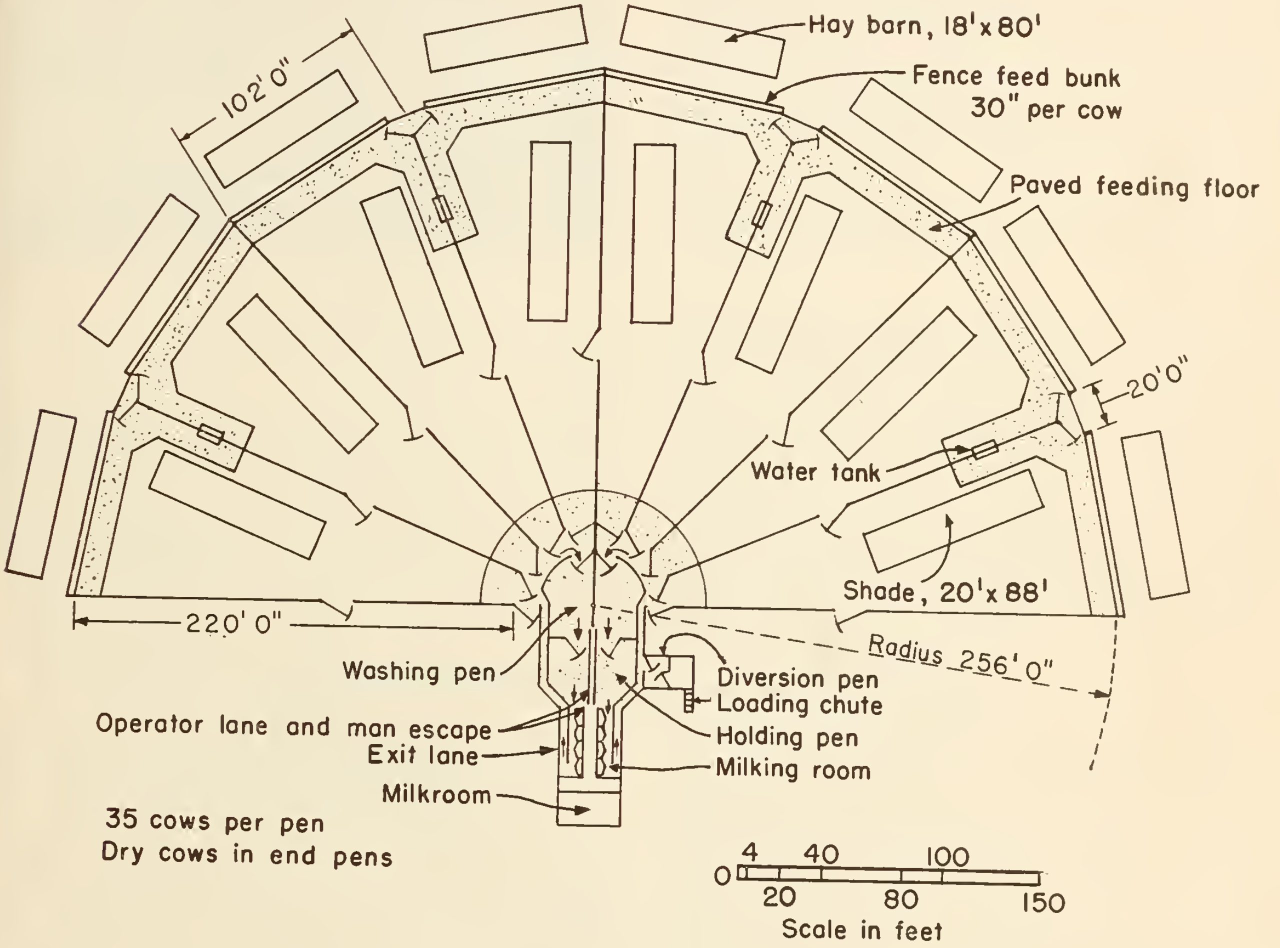

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FIGURE 17.—A wagon-wheel or pie-shaped corral layout for a 200-cow herd in a mild climate. The arrangement permits operating each half independently, with responsibility for each half assigned to a different herdsman.

REMODELING GENERAL-PURPOSE BARNS

Old general-purpose barns are usually unsatisfactory as dairy barns, but often they may be remodeled economically to be used as part of a loose-housing system.

Figure 18 illustrates a plan for a loose-housing layout remodeled from an old general-purpose barn. The paved dairy section can be retained as the feeding area, but the gutter must be filled. Most of the interior other than the feeding area is used for pens and a resting area. If ceilings are low, a tractor-mounted blade can be used to remove the manure pack by working in through large doors at both ends. This may have to be done two or three times each winter.

To provide more headroom, an earth floor may be lowered if this does not undermine the foundation or permit surface water to enter. Sometimes the upper floor can be raised to provide at least

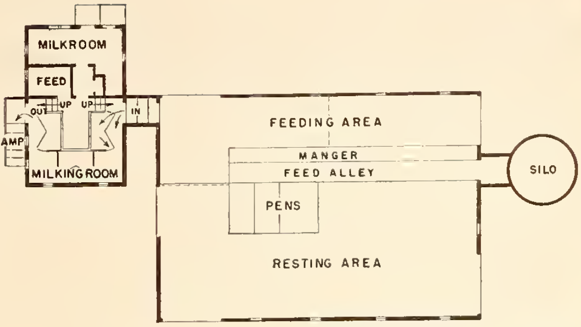

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FIGURE 18.—A general-purpose barn remodeled and adapted for loose housing. The milk area which completes the layout is new.

8 feet under joists. Unnecessary walls and partitions should be removed, leaving the posts that support the overhead haymow and roof. It may be necessary to install extra beams so that some of the supporting posts can be removed to allow working space for power equipment. The last step in conversion is to build a milk area outside the barn. It can be attached to the feeding area by a lane or covered passage if severe weather is expected.

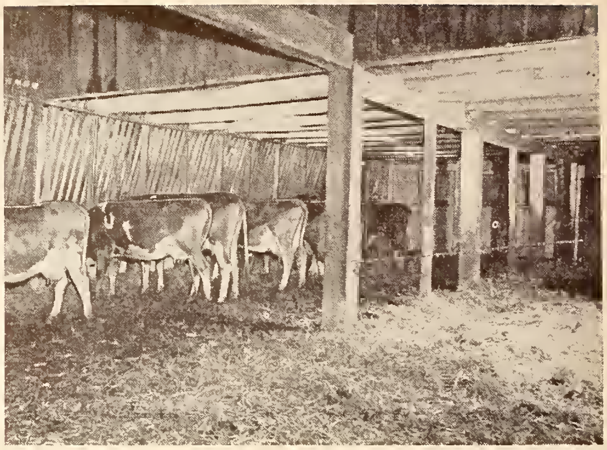

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FIGURE 19.—Feeding arrangements in existing buildings may be satisfactory for loose housing. Electric fence separates feeding and resting areas in this barn.

Existing facilities in old barns, such as the feeders in figure 19, can often be used with few or no changes. If the feeders are next to the resting area, they should be separated from it by an electric or movable fence to avoid unnecessary trampling of the bedding. A large gate or opening at one or possibly both ends of the fence will permit cows to pass freely between the two areas.

CONVERTIBLE AND EXPANSIBLE BARNS

A farmer starting in the dairy business can construct his buildings by steps. The small 5-abreast stall barn (fig. 20, A) may be used temporarily for producing grade B milk without completing the milkroom interior, which can be used for feed storage. After completing the milkroom and adding feeding and resting areas, the building may be used as a floor-level milking barn for 10 or more cows to produce grade A milk. The third step is to convert the milking barn section to an elevated U-shaped milking room with 4 side-entering stalls, suitable for 20 to 45 cows (figs. 3 and 20, B).

The outer walls will not need altering if dimensions are correct from the start. Conversion will consist mainly of adding inside features for the production of grade A milk and shed space to accommodate the herd.

Chores may be mechanized by providing a milk pipeline, bulk cooling tank, silo unloader, and mechanical means for distributing silage along the bunk.

BUILDING COSTS[4]

Although costs for construction materials and labor vary considerably between areas, some examples may be useful in indicating general levels. The small milk area shown attached to the old barn in figure 21 has two elevated, side-opening stalls. It was built in central Illinois in 1952 for about $1,800; $952 of which was for building materials, plumbing, and wiring. The remainder represented the value of farm-family labor used to build the structure. The estimated cost of essential

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[4] From 1952 to 1959 the national average of prices paid by farmers for building materials increased by about 12 percent, wage rates paid farm labor increased by about 23 percent, and wage rates paid common construction labor increased by about 37 percent. Costs for completed construction advanced by about 15 percent to 25 percent, depending on the locality and the proportion of materials and labor costs in the total.

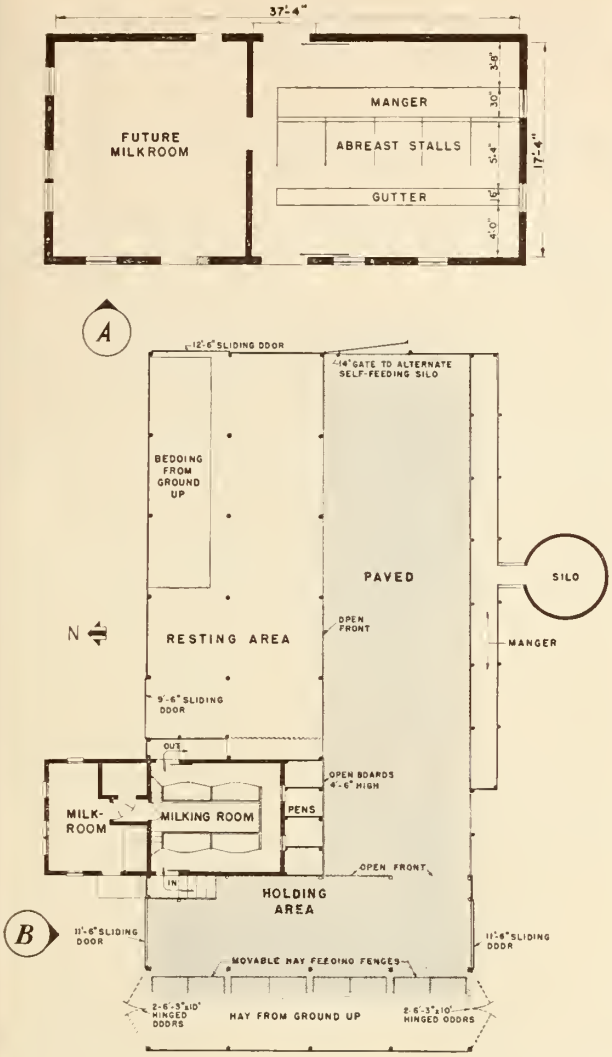

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Figure 20.—The small stall barn shown (A) may be converted in steps to a U-shaped milking room as part of a loose-housing arrangement (B).

PN-1034

Figure 21.—An inexpensive milk area attached to an existing barn will satisfy requirements for production of grade A milk in many areas.

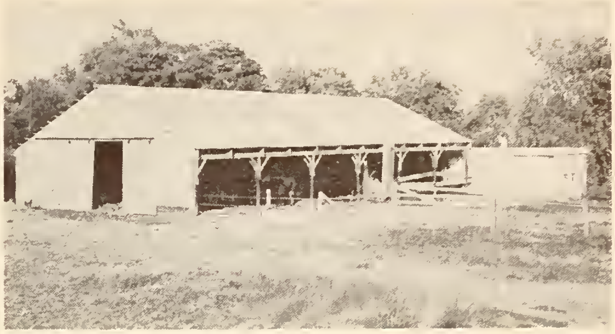

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Figure 22.—This well-arranged loose-housing system includes a milking room and milkroom located at the far right. It met local requirements for production of grade A milk.

equipment was an additional $1,200 and included two bucket-type milking machines, a six-can milk cooler, a water heater, a space heater, and can racks. The building met the Illinois requirements for producing grade A pasteurized milk. It exceeded minimum requirements for production of grade A pasteurized milk in many other areas.

Figure 22 shows a loose-housing layout built in 1951 in the Midwest that met local requirements for production of grade A milk. It is similar to the layout in figure 16 except for the location of the milk area.

The small, flat-roofed milk area includes milkroom, feedbin, and a milking room with three elevated, side-entering stalls, as shown in figure 2. The building, including all labor, plumbing, and wiring, but excluding equipment, cost $3,540.

The resting-feeding shed includes feeding area, resting area, and hay and bedding storage. It accommodates 30 cows, allowing 50 square feet of floor area per cow in the resting area. It cost $2,760, including pavement in the feeding area and a 20-foot paved approach along the entire open side of the building. This amounts to 90 cents per square foot of floor area. There is no silo. Farm-family labor valued at $160 was used for laying the concrete inside and in front of the shed, and for some nonskilled tasks. All labor for building construction was hired.

Total building costs, including family labor, were $6,300, or $210 per cow. Cost of new equipment, including piping for milk and space heaters, would have amounted to $50 to $60 more per cow.

Observations indicate that the necessary buildings and equipment for a complete loose-housing system could be built, at 1960 prices, for about $400 to $450 per cow, using hired labor and buying materials at retail. The system would include the milking room and milkroom with milk pipeline and other new equipment, pole-frame feeding and resting sheds, silage bunks, pens for young stock, paved lots, and an upright silo.

OPERATION AND MANAGEMENT SUGGESTIONS

Successful use of a milking room with loose housing depends largely on good management. Experience has shown the importance of these points:

1. Handle cows gently when training them for a milking room. Some cows need to be led or driven into the milking stall only once. Others may have to be led a second or third time, but after this they usually enter stalls readily.

2. Make elevated stall milking room entrance and exit facilities safe and easy for the cow. Broom-finish the concrete to roughen it for better footing. Give steps a 4- to 6-inch rise and a 24- to 30-inch tread. Rounding off the nose of a step on about a 1-inch radius eliminates the sharp edge and reduces injury hazard—similarly coving the bottom makes for easier cleaning. Slope ramps about 1 foot vertical to 4 to 6 feet horizontal. Make the finish extra rough, with transverse grooves about 2 inches in diameter and 12 inches apart to help prevent slipping. A level platform about 6 feet long just outside the exit door gives a cow a chance to get her bearings before descending. A canopy or other shelter from rain or snow helps prevent icy footing. Electric heating cable in the concrete helps melt snow, prevent freezing, and dry wet spots.

3. Where bucket-type machines are used with side-entering stalls, provide one or two more stalls than the number of machines. Cows can be readied for milking in the extra stalls, thus reducing idle time for the machines. With piped milk a milker unit may be installed at each stall.

4. If concentrates are fed in the milking room or milking barn, store in adjoining or overhead bins. Various kinds of mechanical equipment may be used for feeding. One of the simplest and most economical methods of feeding is to fill a small feed cart at the bin and move it to a spot in the operator area next to a feedbox. Feed is then put in the feedbox with a hand scoop. Only a few steps are required to feed any cow. Another simple method is to have a feedbin on one side of the operator area at the same height as the elevated stalls on the opposite side. The bin extends almost the length of the milking stalls. Feeding is done with a hand scoop. In the herringbone milking room, concentrates are usually distributed to the individual feed hoppers mechanically or by gravity, with the release controls operated from the entrance end of the operator area.

5. Arrange for efficient feeding procedures. Most cows fed concentrates in the milking room learn to eat in about 6 minutes, and 7½ minutes should be ample for the slow ones. The time available depends on how fast cows are milked, number of stalls, order of operations, and number of machines. A good procedure is to release a cow as soon as the teat cups are removed and put feed in the feedbox while the next cow is entering, so that she will have the maximum time to eat. In the herringbone, feed is released to the hoppers as a group of cows enters the stall area. Adequate time is available to consume the feed before the last cow in the group is milked out and the group released. Most cows will have ample time to eat their grain, and operators can work efficiently with the following combinations:

(a) One operator, 3-in-line elevated, side-entering stalls, 2 bucket-type machines.
(b) One operator, 3-in-line elevated, side-entering stalls, 3 machines with piped milk.
(c) One operator, 4 elevated, side-entering stalls in a U-shape or a walk-through tandem, 2 bucket-type machines or 2 swinging pipeline milker units.
(d) For the smallest herds, 1 operator, 2 elevated stalls, and 1 bucket-type machine.
(e) For the larger herds, 4 to 8 elevated, side-entering stalls in a U-shape or 2-row walk-through tandem with 4 stationary or 2 swinging pipeline milker units per operator.
(f) Two machines with 2 elevated stalls is a good combination for some operators, but the most efficient operators can handle a third and in some cases a fourth stall to good advantage.
(g) One operator, 3 to 5 milking units, in the double-sided herringbone.

6. When ample water is available, keep the floor clean by washing down as required. If water is scarce, scoop up manure that may be dropped in the

milking room and wash the floor with a hose and stiff brush after the cows are milked. Some local areas permit the liming of floors after cleaning, but washing is quicker and more sanitary.

7. Clean the paved lot and the feeding and holding areas daily, or as required. Allow the manure pack in the resting area to build up during the winter.

8. Provide a restraining chute, squeeze gate, or stanchion for dehorning, trimming, or other veterinary work.

HOW TO OBTAIN PLANS

Working drawings of plans for farm buildings may usually be obtained through your county agricultural agent or from the Extension agricultural engineer at your State agricultural college. There is usually a small charge.

Plan numbers shown with drawings in this bulletin indicate plans included in the Cooperative Farm Building Plan Exchange.

If working drawings of these plans are not available in your State, write to the U.S. Department of Agriculture, Agricultural Engineering Research Division, Plant Industry Station, Beltsville, Maryland. The U.S. Department of Agriculture does not distribute drawings, but will direct you to a State that does distribute them.

Growth Through Agricultural Progress

U.S. GOVERNMENT PRINTING OFFICE: 1961

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